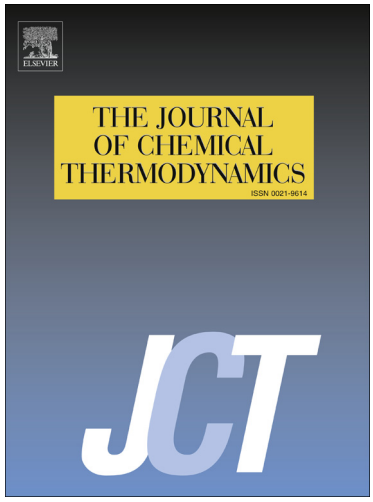

Thermodynamics of Hydrolysis of Cellulose to Glucose from 0 to 100ºC: Cellulosic Biofuel Applications and Climate Change Implications

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Abstract

Hydrolysis of cellulose to glucose is a key reaction in renewable energy from biomass and in mineralization of soil organic matter to CO_2. Conditional thermodynamic parameters, $\Delta_{hyd}G'$, $\Delta_{hyd}H'$, and $\Delta_{hyd}S'$, and equilibrium glucose concentrations are reported for the reaction $C_6H_{10}O_5(cellulose) + H_2O(l) \rightleftarrows C_6H_{12}O_6(aq)$ as functions of temperature from 0 to 100°C. Activity coefficients of aqueous glucose solution were determined as a function of temperature. The reaction free energy $\Delta_{hyd}G'$ becomes more negative as temperature increases, suggesting that producing cellulosic biofuels at higher temperatures will result in higher conversion. Also, cellulose is a major source of carbon in soil and is degraded by soil microorganisms into CO_2 and H_2O. Therefore, global warming will make this reaction more rapid, leading to more CO_2 and accelerated global warming by a positive feedback.

Key Words: Renewable energy; Biomass; Soil organic matter; Lignocellulose; Global warming; Glucose activity coefficient.

Graphical abstract: